

Notice of Allowability

Application No.

10/709,314

Examiner

Fernando L. Toledo

Applicant(s)

DORIS ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the application filed on 28 April 2004.
2. ☒ The allowed claim(s) is/are 1-20.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 20040605; 20040428
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 20050930.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Lisa Ulrich on 30 September 2005.

The application has been amended as follows:

In the claims:

1. (amended) A method for forming a gate structure for semiconductor device, the method comprising:

defining a conductive metal sacrificial structure on a substrate;

forming a reacted metal film on sidewalls of said conductive metal sacrificial structure;

and

selectively removing unreacted portions of said conductive metal sacrificial structure.

2. (amended) The method of claim 1, further comprising forming a protective cap over said conductive metal sacrificial structure prior to forming said reacted metal film.

3. (amended) The method of claim 2, further comprising trimming a portion of said reacted metal film so as to ~~define a pair of gate conductors that are electrically isolated from one another.~~

4. (amended) The method of claim 1, wherein said conductive metal sacrificial structure ~~further~~ comprises at least one of: cobalt, nickel, titanium, tantalum, palladium, and platinum.

5. (amended) The method of claim 4, wherein said reactive metal film ~~further~~ comprises at least one of: cobalt silicide, cobalt nitride, nickel silicide, nickel nitride, titanium silicide, and titanium nitride.

6. (amended) The method of claim 1, wherein said reacted metal film is formed by reacting said conductive metal sacrificial structure with a reactive gas in the presence of heat.

7. (amended) The method of claim 1, wherein said reacted metal film is formed by annealing sidewall spacers formed on said conductive metal sacrificial structure, said sidewall spacers comprising a thermally reactive material with respect to said conductive metal sacrificial structure.

8. (amended) A method for forming a gate structure for a semiconductor device, the method comprising:

forming a gate dielectric material on a substrate;

forming an etch stop layer over said gate dielectric material;

forming a conductive metal layer over said etch stop layer;

forming a protective layer over said conductive layer;

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patterning and removing portions of said protective layer and said conductive metal layer so as to define a conductive metal sacrificial structure and a protective cap thereupon;

forming a reacted metal film on sidewalls of said conductive metal sacrificial structure by reacting said conductive metal sacrificial structure with a reactive gas in the presence of heat; and removing at least a portion of said protective cap, selectively removing exposed, unreacted portions of said conductive sacrificial structure, and removing exposed portions of said etch stop layer.

9. (amended) The method of claim 8, further comprising trimming a portion of said reacted metal film ~~so as to define a pair of gate conductors that are electrically isolated from one another.~~

10. (amended) The method of claim 9, wherein said trimming further comprises:

removing a portion of said protective cap and said reacted metal film, thereby reexposing at least one of said sidewalls of said conductive metal sacrificial structure; and

isotropically etching said reexposed conductive metal sacrificial structure.

11. (amended) The method of claim 10, wherein unexposed portions of said conductive metal sacrificial structure are remaining in one of said pair of gate conductors, thereby defining a wider other of said pair of gate structure with respect to the gate conductors.

12. (amended) The method of claim 8, wherein said reactive gas ~~further~~ comprises at least one of: SiH₄, NH₃ and N₂ plasma.

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13. (amended) The method of claim 12, wherein said ~~further~~ comprises at least one of: cobalt silicide, cobalt reactive metal film nitride, nickel silicide, nickel nitride, titanium silicide and titanium nitride.

14. (amended) A method for forming a gate structure for a semiconductor device, the method comprising:

forming a gate dielectric material on a substrate;

forming an etch stop layer over said gate dielectric material;

forming a conductive metal layer over said etch stop layer;

forming a protective layer over said conductive metal layer;

patterning and removing portions of said protective layer and said conductive metal layer so as to define a conductive metal sacrificial structure and a protective cap thereupon;

forming a reacted metal film on sidewalls of said conductive metal sacrificial structure by annealing said conductive metal sacrificial structure and a thermally reactive layer formed in contact with said sidewalls of said conductive metal sacrificial structure; and

removing said protective cap, selectively removing unreacted portions of said conductive sacrificial structure and said thermally reactive layer, and removing exposed portions of said etch stop layer.

15. (amended) The method of claim 14, further comprising trimming a portion of said reacted metal film ~~so as to define a pair of gate conductors that are electrically isolated from one another.~~

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16. (amended) The method of claim 15, wherein said conductive metal sacrificial structure ~~further~~ comprises at least one of: cobalt, nickel, titanium, tantalum, palladium and platinum.

17. (amended) The method of claim 16, wherein said thermally reactive layer ~~further~~ comprises a silicon layer.

18. (amended) The method of claim 17, wherein said reactive metal film ~~further~~ comprises at least one of: cobalt silicide, nickel silicide and titanium silicide.

19. (amended) The method of claim 14, wherein said etch stop layer ~~further~~ comprises at least one of: tungsten, tantalum nitride, tungsten silicide, tantalum silicide, palladium, silicide, platinum silicide and titanium silicide.

2. The following is an examiner's statement of reasons for allowance: Kadosh et al. in the U. S. Patent 6,383,872 B1 substantially discloses the claimed invention. However, Kadosh does not disclose, teach or suggests forming a conductive metal sacrificial structure, forming a reacted metal film on sidewalls of said sacrificial structure and selectively removing unreacted portions of the sacrificial structure.

3. Kadosh on the other hand discloses forming a sacrificial structure with a resin or a spin-on-coating layer and then blanket depositing a polysilicon layer, etching the polysilicon layer and then removing the sacrificial structure. The invention of Kadosh cannot be modified to read on the claimed invention.

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4. Also, the article of Takahashi et al. "New Platinum Silicide Formation Method Using Reaction Between Platinum and Silane" discloses forming a metal structure and reacting the surface of the metal structure. However, Takahashi is silent in reacting the sidewalls of the metal structure and then removing the unreacted portions of the metal structure.

Neither Kadosh nor Takahashi, alone or in combination teaches the limitations of the claimed invention, therefore the claimed invention as a whole is neither anticipated nor rendered obvious over the prior art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando L. Toledo whose telephone number is 571-272-1867. The examiner can normally be reached on Mon-Thu 7am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

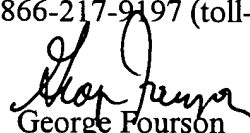
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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



FToledo

30 September 2005



George Fourson
Primary Examiner
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